Finite Element (FE) modelling and updating of welded joint for dynamic study of exhaust structure

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Abstract.
An exhaust structure is experienced dynamic loads caused by engine operational and road surface condition that affected its durability and performance. Hence, the purpose of this study is to perform finite element (FE) modelling of exhaust structure and the used of updating approach to improve its dynamic behaviour. Due to its design, exhaust structure is built-up from several parts connected with welded joints. These welded joints significantly contribute to the dynamic behaviour of the structure. Four types of element connector that are RBE2, CBAR, CBEAM and CELAS have been used to replicate FE model of welded joint on the structure. Modal parameters (natural frequency and mode shape) of the FE model have been obtained from normal mode analysis using finite element analysis (FEA) software, MSC. Nastran/Patran. The precision of numerical predicted result from FEA is compared with its measured counterpart. The measured test data obtained through experimental modal analysis (EMA) using impact hammer and roving accelerometers under free-free boundary conditions. Under correlation process, CBAR element connector was chosen to model the welded joint due to its accurate prediction of natural frequency and contains updating parameters. FE model updating process was performed to improve the correlation between EMA and FEA. Ahead of updating process, sensitivity analysis was done to select the most sensitive updating parameter. As a result, total percentage error of natural frequency for updated CBAR model is reduced significantly from 8.74 % to 3.45 %. Consequently, CBAR element connector was chosen as the most reliable joint element in FE model to represent welded joint on exhaust structure.